Articles

Risk for AIDS in Multiethnic Neighborhoods in San Francisco, California

The Population-Based AMEN Study

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To examine the actual and potential spread of human immunodeficiency virus (HIV) from an acquired immunodeficiency syndrome (AIDS) epicenter to surrounding neighborhoods, we studied the prevalence of the viral infection and AIDS risk behaviors from 1988 to 1989 in a representative sample of unmarried whites, African Americans, and Hispanics living in San Francisco. We surveyed 1,770 single men and women aged 20 to 44 years (a 64% response rate) in a random household sample drawn from 3 neighborhoods of varying geographic and cultural proximity to the Castro District where the San Francisco epidemic began. Of 1,369 with blood tests, 69 (5%) had HIV antibodies; all but 5 of these reported either homosexual activity (32% HIV-positive; 95% confidence interval [CI] = 23%, 41%), injection drug use (5% HIV-positive; CI = 1%, 14%), or both (59% HIV-positive; CI 42%, 74%). Homosexual activity was more common among white men than among African-American or Hispanic men, but the proportion of those infected was similar in the 3 races. Both the prevalence of homosexually active men and the proportion infected were much lower in the 2 more outlying neighborhoods.

Risk behaviors in the past year for acquiring HIV heterosexually—sex with an HIV-infected person or homosexually active man or injection drug user, unprotected sexual intercourse with more than 4 partners, and (as a proxy) having a sexually transmitted disease—were assessed in 1,573 neighborhood residents who were themselves neither homosexually active men nor injection drug users. The prevalence of reporting at least 1 of these risk behaviors was 12% overall, and race-gender estimates ranged from 5% among Hispanic women to 21% among white women. We conclude that in San Francisco, infection with HIV is rare among people who are neither homosexually active nor injection drug users, but the potential for the spread of infection is substantial, as 12% of this group reported important risk behaviors for acquiring the virus heterosexually.

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The epidemic of the acquired immunodeficiency syndrome (AIDS) in San Francisco, California, has been marked by the rapid and virulent spread of infection among homosexually active men living in the Castro District.[1-3] Estimates derived from population-based seroprevalence studies of that neighborhood suggested that 49% of homosexually active men were infected with the virus by 1985. Massive and aggressive interventions developed by a coalition of community groups and public health officials[4,5] were effective in curbing further spread of the human immunodeficiency virus (HIV) among homosexually active men in that community.[6,7] Despite these successes, HIV infection has continued to spread in San Francisco, as evidenced by recent seroconversion among those participating in long-term cohort studies[8] and as suggested by the growing number of AIDS cases not attributable to male homosexual activity or injection drug use.[9]

The general patterns of such viral dissemination are well described. Over time, AIDS cases are reported from an ever-enlarging geographic area following patterns of hierarchic diffusion (spread from one population center to another distant one along travel routes) and spatial contagion (spread into areas contiguous with an epicenter).[10] The first reports of cases of AIDS, which came from such disparate places as New York City, Los Angeles, and San Francisco, illustrate hierarchic diffusion[11]; rates of infection among injection drug users in the northeastern United States, which vary inversely with distance from New York City, illustrate spatial contagion.[12] In local areas, HIV has spread within the sexual networks formed by gay men as well as in the sexual and

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ABBREVIATIONS USED IN TEXT

AIDS = acquired immunodeficiency syndrome
AMEN = AIDS in Multiethnic Neighborhoods
CDC = Centers for Disease Control
ELISA = enzyme-linked immunosorbent assay
HIV = human immunodeficiency virus

needle-sharing networks formed by injection drug users. The sexual networks of those groups include people who are not themselves homosexually active men or injection drug users, a social connection that creates the potential for broad dissemination of the virus.

To study patterns of current and potential viral dissemination at the community level, we designed the AIDS in Multiethnic Neighborhoods (AMEN) Study. We selected ethnically mixed neighborhoods that were assumed to be vulnerable to the spread of HIV because of the close proximity to the Castro District and the high proportion of residents in treatment for injection drug use or gonorrhea. The diversity of the sample allowed us to examine the distribution of HIV risk behaviors and infection across groups defined by race, gender, and sexual orientation and to describe the sexual contact between those reporting the major high-risk behaviors—homosexually active men and injection drug users—and other members of the population residing in spatially contiguous areas. We used household probability sampling to provide a strong basis for generalizing the findings to similar high-risk communities in close geographic proximity to an AIDS epicenter.

Subjects and Methods

Selection of the Target Population

The selection of the target population was guided by three objectives: to identify a subpopulation of San Francisco residents who are, by objective indicators, at an increased risk of the transmission of HIV; to permit comparisons, with respect to HIV risk factors and HIV antibody status, among various subgroups of the city's population; and to allow efficient sampling of eligible study subjects by area probability sampling methods. These considerations led to the following definition of the target population: currently unmarried men and women, aged 20 to 44 years at initial contact, living in 16 census tracts of San Francisco. These tracts are characterized by high rates of reportable sexually transmitted diseases among women, by high rates of admission to drug detoxification programs, and by roughly equal numbers of African-American, white, and Hispanic residents.

The 16 tracts make up three distinct areas of the city: the Western Addition, the Mission District, and the Bayview-Hunter's Point District. According to the 1980 census, the populations of the Western Addition and the Bayview-Hunter's Point District were predominantly African American (71% and 87%, respectively), whereas the majority of the population of the Mission District, 51%, was Hispanic with a relatively small representation of African Americans (less than 5%). As shown in Figure 1, the Western Addition and Mission District lie along the northern and eastern borders of the Castro District, a district that was sampled in the San Francisco Men's Health Study because of its high prevalence of AIDS cases.

The population of the 16 tracts in 1980 was 77,200. Of this total, an estimated 27% (about 20,800) met the eligibility requirements for participation in the baseline survey. The distribution of the eligible population by race or ethnicity, based on ratio estimates from the 1980 US Census, was approximately 41% African American, 28% Hispanic, and 31% white and other racial groups.

Sampling Methods

The sample was designed so that each eligible person in the target population had the same probability of being selected—that is, the sample is "self-weighting." Within each of the 16 census tracts, blocks were chosen at random with probability proportional to the number of housing units in the block. Within each block, housing units were selected by

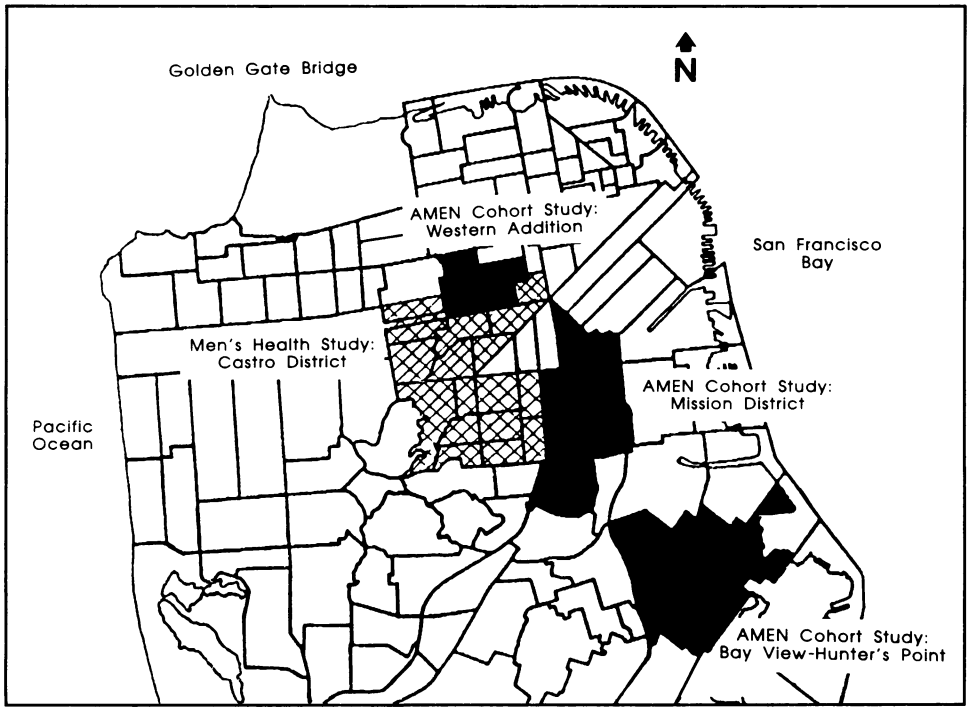

Figure 1.—The map of San Francisco shows the 3 neighborhoods surveyed in the AIDS in Multiethnic Neighborhoods (AMEN) Cohort Study **(solid black)** and the Castro District surveyed in the Men's Health Study (Winkelstein et al[7]) **(crosshatched).**

systematic random sampling. Each household in the target area has the same probability of falling in the sample (about 1 in 6.2). A total of 4,234 households were invited to participate in the baseline survey. Based on data collected in the fieldwork phase of the survey, 2,755 persons meeting the survey criteria were living in the selected households during the period of fieldwork.

Field Methods

Field operations were conducted by field-workers recruited and trained by the staff of the Survey Research Center of the University of California, Berkeley. In addition to training in administering interviews, each field-worker was certified to draw a specimen of blood by venipuncture. The protocol for contacts with selected households consisted of the following sequence of activities: An advance letter explaining the purpose of the survey was sent to each selected household before the first personal contact; at the initial home visit, a field-worker attempted to complete an enumeration interview to determine whether any persons eligible for participation were living in the household; if possible, the field-worker attempted to complete the baseline survey protocol with eligible members of the household during the initial home visit and to set up an appointment for a subsequent contact; and for each person identified as eligible in the enumeration phase, the complete home visit protocol was done. This consisted of

- Obtaining signed informed consent for participation;
- Administering a 45-minute face-to-face interview conducted in private and covering a wide range of HIV risk factors, psychosocial inventories, sociodemographic items, and information that would enable field-workers to recontact the participant for subsequent home visits;
- Collecting a specimen of blood by venipuncture in the home or in a nearby clinic;
- Telling each participant who donated blood how to obtain the results of the HIV antibody assay;
- Providing a $20 payment to compensate participants for their time.

All components of the home visit protocol, including the interview, were administered in Spanish when participants indicated a preference for Spanish.

Fieldwork for the baseline survey began in April 1988 and concluded in June 1989. Throughout this period, field-workers made repeated telephone calls to contact eligible persons who were not available at initial home visits and to reschedule home visits that had been missed or canceled. A special corps of highly trained interviewers attempted to complete the home visit protocol with eligible persons who had expressed a reluctance to participate in earlier contacts.

Serologic Tests

Serum was collected in 5-ml Vacutainer tubes, was refrigerated, and was delivered to the California State Viral and Rickettsial Disease Laboratory within 48 hours of collection. The laboratory assay employed a licensed commercial enzyme-linked immunosorbent assay (ELISA) kit from either Du Pont Medical Products or Genetics Systems following instructions on the package insert. Positive results were confirmed by a combination of a second ELISA from another manufacturer and an indirect immunofluorescence procedure developed in that laboratory.[13] Western blot and radioimmunoprecipitation testing were done on specimens considered discrepant by primary tests.

Instruments

The risk behaviors examined in this study do not carry an equivalent probability of HIV infection[14] but were chosen because they all increase the risk for HIV infection.[15-17] Risk behaviors were assessed by an interviewer reading the following questions:

- Male homosexual activity: "Over the last 12 months [have you had] sexual intercourse with another man . . . defined as follows: you put your penis in your partner's mouth or rectum, or your male partner puts his penis in your mouth or rectum?"
- Injection drug use: "Have you . . . injected any drugs into your veins or under your skin . . . within the last 12 months?"
- Having an HIV-infected sex partner: "[Has your partner of the past 12 months] ever had a test to detect the presence of the antibodies to the AIDS virus?" combined with "What did he or she say the result of his or her test was?"

TABLE 1.—*Recruitment for the AMEN Cohort Study and Participation of the Sample (n=2,755)*

Sex and Race Distribution	Enumerated, No.	Interviewed No.	Interviewed (%)
Men	**1,426**	**880**	**(62)**
White	586	397	(68)
African American	291	167	(57)
Hispanic	403	240	(60)
Other	112	76	(68)
Race unknown	34	0	(0)
Women	**1,329**	**890**	**(67)**
White	437	339	(78)
African American	445	289	(65)
Hispanic	323	195	(60)
Other	98	67	(68)
Race unknown	26	0	(0)
Total	2,755	1,770	(64)

AMEN = AIDS in Multiethnic Neighborhoods

- Having a homosexually active male sex partner (among women): "[Has your partner of the past 12 months] had sexual intercourse with another man at any time in the last 10 years?"
- Having a sex partner who uses injection drugs: "[Has your partner of the past 12 months] injected drugs into his or her veins or under his or her skin at any time in the last 10 years?"
- Having a sexually transmitted disease: "Have you . . . had any of the following diseases or conditions . . . during the last 12 months?" followed by individual questions about "syphilis," "gonorrhea or clap," "pelvic inflammatory disease," and "herpes sores in the genital or anal region";
- Having unprotected sex with more than four partners. questions about whether a condom was used "every time" for vaginal or rectal intercourse, asked individually for each of up to ten partners over the past 12 months.

The frequency of missing values for these risk behavior variables varied but was less than 4% in each case; these missing values were imputed to be zero. (The risk behaviors in Table 3 are based on similar items but refer to the longer

periods of time indicated in the footnote.) Near the end of the interview, race or ethnicity was assessed based on the respondent's choosing "which of the groups there best describes you" while looking at a page with seven printed categories. The subject's age was based on the birth date provided by the respondent, his or her education was established by the response to standard categories, and his or her income was determined by the respondent signifying the letter of the appropriate category from a list printed on a page.

Results

Demographic Characteristics of the Sample

A total of 4,232 households were contacted as part of the initial screening attempt to identify eligible respondents. Of those households, 95% were successfully enumerated. In all, 2,755 potential respondents were identified, of whom 1,770 (64%) agreed to be interviewed. Among whites, Hispanics, and those of other ethnic backgrounds, men slightly outnumbered women among those enumerated. Among African Americans, men were only 40% of those identified as possible participants.

Among those enumerated, women were more likely to participate in the survey than men (67% versus 62%, Table 1). Variation by race or ethnicity was also apparent: the response rate was 72% for whites, 62% for African Americans, 60% for Hispanics, and 68% for others. In considering gender and race or ethnicity together, we found the highest response rate (78%) among white women and the lowest among African-American men (57%). Examining response rates by age group and neighborhood (not shown in the table) revealed no significant differences.

The sample of 1,770 people interviewed comprised whites (41%), African Americans (26%), and Hispanics (25%); the remaining participants (8%) reported a diverse mixture of ethnic backgrounds (Table 2).[18] The sample was almost equally divided between men (880) and women (890). More than half of those surveyed reported an income of less than $18,000 per year. Two thirds had less education than a college degree, and half of these had a high school education or less.

The proportion of African Americans in our sample differed from that reported in the 1980 census. This shift was most pronounced in the Western Addition, where African Americans constituted 71% of single residents aged 20 to 44

TABLE 2.—*Demographic Characteristics and Human Immunodeficiency Virus (HIV) Antibody Seroprevalence of 1,770 Interviewees*

Characteristic	Total No. of Subjects	Serum Specimen Collected		HIV Antibodies		
		No.	(%)	No.	Point Estimate, %	95% CI, %*
Age, yr						
20-24	467	362	(78)	3	0.8	0.2-2.4
25-29	475	372	(78)	15	4.0	2.3-6.6
30-34	323	256	(79)	19	7.4	4.5-11.3
35-39	307	227	(74)	20	8.8	5.5-13.3
40-44	198	152	(77)	12	7.9	4.1-13.4
Total	1,770	1,369	(77)	69	5.0	3.9-6.3
Ethnicity and gender						
Men						
White	397	327	(82)	47	14.4	10.8-18.7
African American	167	117	(70)	7	6.0	2.4-11.9
Hispanic	240	180	(75)	8	4.4	1.9-8.6
Other	76	51	(67)	4	7.8	2.2-18.9
Total	880	675	(77)	66	9.8	7.6-12.3
Women						
White	339	282	(83)	1	0.4	0.0-2.0
African American	289	211	(73)	1	0.5	0.0-2.6
Hispanic	195	155	(80)	1	0.6	0.0-3.5
Other	67	46	(69)	0	0.0	0.0-6.3
Total	890	694	(78)	3	0.4	0.1-1.3
Income						
$0-5,999	414	328	(79)	4	1.2	0.3-3.1
$6,000-17,999	664	534	(80)	19	3.6	2.2-5.5
$18,000-29,999	442	335	(76)	28	8.4	5.6-11.9
$30,000-49,999	194	133	(69)	16	12.0	7.0-18.8
$50,000+	45	32	(71)	2	6.3	0.8-20.8
Total†	1,759	1,362	(77)	69	5.1	4.0-6.4
Education						
Less than high school	246	204	(83)	8	3.9	1.7-7.6
High school graduate	374	284	(76)	8	2.8	1.2-5.5
Some college	650	487	(75)	31	6.4	4.4-8.9
College degree	307	235	(77)	13	5.5	3.0-9.3
Postgraduate	181	149	(82)	9	6.0	2.8-11.2
Total†	1,758	1,359	(77)	69	5.1	4.0-6.4

*Approximate 2-sided 95% confidence intervals (CI) for proportions were calculated using the exact relationships among the binomial, β, and F distributions (from Johnson and Katz[18]). When the observed count was 0, the same method was used to calculate an approximate 1-sided 95% CI.

†Responses were missing for income in 11 cases and for education in 12 cases.

in the 1980 census but only 32% of the respondents in our study. African Americans constituted 87% of the residents of the Bayview-Hunter's Point District in the 1980 census and 5% of the residents of the Mission District, but in our study African Americans represented 77% of respondents from Bayview-Hunter's Point and 4% of the respondents from the Mission District.

Human Immunodeficiency Virus Infection

Of the 1,770 subjects in the AMEN cohort study, 1,369 (77%) agreed to have their blood tested for HIV antibodies. The two samples had similar distributions by race and gender (Table 2) and similar frequencies of risk behaviors. Homosexually active men were slightly less likely to be tested (Table 3), but the 60 persons who reported having injected drugs in the previous 12 months were significantly more likely to be tested than nonusers (90% versus 77%, $P < .05$), as were the 190 respondents who reported at least one lifetime episode of injection drug use (90% versus 76%, $P < .0001$).

Among those tested, 69 (5%) had antibodies (Table 2). Infection rates were much higher among men (n = 66) than among women (n = 3). Infection rates were higher among whites, among those reporting a higher annual income, and among those with more years of education, reflecting the demographic characteristics of homosexually active men in San Francisco. Of the 66 HIV-infected men, 62 reported one or both of the two major risk behaviors for HIV transmission (Table 3); 35% were both homosexually active and injection drug users, 55% were homosexually active only, and 5% were injection drug users only. Among the 23 infected men who were homosexually active injection drug users, 70% were white, 13% were African American, 13% were Hispanic, and 4% were in other racial groups. Among the 36 infected men who were homosexually active only, the distribution was 78%, 6%, 8%, and 8%, respectively. Among the three infected men who were injection drug users only, one was white, one was African American, and one was Hispanic.

The two HIV-infected men with other risk behaviors were both white: One had an HIV-infected female sex partner, and the other reported an injection drug-using female sex partner and sex with more than four partners without a condom in the past year. Of the two infected men who did not report risk behaviors, one was African American and one was Hispanic. Of the three infected women, two (one white and one Hispanic) reported injection drug use and one (an African-American woman) did not report any of the risk behaviors listed in the footnote to Table 3.

Table 3 provides population-based estimates for prevalence of infection in these risk groups. The HIV seroprevalence was 59.0% among men reporting both homosexual activity and injection drug use, 31.9% among those reporting homosexual activity, and 5.0% among those reporting injec-

TABLE 3.—*Human Immunodeficiency Virus (HIV) Antibody Seroprevalence in Study Group by Risk Group*

Risk Group*	Total No. of Subjects	Serum Specimen Collected		HIV Antibodies		
		No.	(%)	No.	Point Estimate, %	95% CI, %†
Men						
Homosexually active	157	113	(72)	36	31.9	23.4-41.3
Injection drug use (IDU)	70	60	(86)	3	5.0	1.0-13.9
Homosexually active and IDU	43	39	(91)	23	59.0	42.1-74.4
Other risk behavior	51	39	(77)	2	5.1	0.6-17.3
No identified risk	559	424	(76)	2	0.5	0.1-1.7
All men	880	675	(77)	66	9.8	7.6-12.3
Women						
IDU	77	71	(92)	2	2.8	0.3-9.8
Other risk behavior	80	68	(85)	0	0.0	0.0-4.3
No identified risk	733	555	(76)	1	0.2	0.0-1.0
All women	890	694	(78)	3	0.4	0.1-1.3

*Risk group classifications were based on reported injection drug use (ever, in whole life), homosexual activity (in past 10 years), and the following other risk behaviors: having a sex partner who is HIV infected (past 10 years), being a woman with a homosexually active male sex partner (past year), having a sex partner who injects drugs (past year), having had a sexually transmitted disease (past year), or having had sex with more than 4 partners without a condom (past year).

†Approximate 2-sided 95% confidence intervals (CI) for proportions were calculated using the exact relationships among the binomial, β, and F distributions (from Johnson and Katz[18]). When the observed count was 0, the same method was used to calculate an approximate 1-sided 95% CI.

TABLE 4.—*Distribution of High-Risk Behaviors for Human Immunodeficiency Virus (HIV) Infection in the Past Year in a Random Household Sample of Single Men and Women*

Risk Behavior in Past Year	Homosexually Active Men, Injection Drug Users, or Both (n=197), %	All Others (n=1,573), %	Total Subjects (n=1,770), %
Male homosexual activity (among men)	--	0	17
Injection drug use	--	0	3
Having an HIV-infected sex partner	13	0	1
Having a homosexually active male sex partner (among women)	15	2	2
Having a sex partner who injects drugs	27	5	7
Having a sexually transmitted disease	11	5	6
Having unprotected sex with more than 4 partners	6	3	4

TABLE 5.—*Distribution of Risk Behaviors by Race and Gender Among the Persons in This Study Who Are Not Homosexually Active Men or Injection Drug Users*

Risk Behavior in Past Year	White		African American		Hispanic		Other		Total
	Men (n=277), %	Women (n=325), %	Men (n=144), %	Women (n=285), %	Men (n=222), %	Women (n=189), %	Men (n=66), %	Women (n=65), %	(n=1,573), %
Having an HIV-infected sex partner	0	0	0	0	0	0	0	0	0
Having a homosexually active male sex partner (among women)	NA	4	NA	0	NA	1	NA	2	2
Having a sex partner who injects drugs	7	9	1	4	3	3	3	2	5
Having a sexually transmitted disease	5	9	6	6	2	3	0	3	5
Having unprotected sex with more than 4 partners	5	3	6	3	5	0	3	0	3
1 Risk behavior	12	18	11	8	8	4	6	6	10
More than 1 risk behavior	2	3	1	2	1	1	0	0	2

HIV = human immunodeficiency virus, NA = not applicable

TABLE 6.—*Distribution of Human Immunodeficiency Virus (HIV) Antibody Prevalence and of Risk Behaviors in Entire Study Population by Neighborhood*

Infection Status and Risk Behavior	Neighborhood			Total, %	P Value*
	Western Addition, %	Bayview-Hunter's Point, %	Mission District, %		
HIV infection, No.	**425**	**230**	**714**	**1,369**	
Prevalence of HIV antibodies	12	2	2	5	<.001
Risk behavior in past year, No.	**566**	**298**	**906**	**1,770**	
Male homosexual activity (among men)	28	10	11	17	<.001
Injection drug use	3	4	4	3	NS
Having an HIV-infected sex partner	3	0	1	2	<.001
Having a homosexually active male sex partner (among women)	5	0	2	2	<.001
Having a sex partner who injects drugs	8	6	7	7	NS
Having a sexually transmitted disease	8	5	4	6	<.02
Having unprotected sex with more than 4 partners	4	4	3	4	NS

NS = not significant

*P values represent χ^2 test for heterogeneity among neighborhoods.

tion drug use. The prevalence among men reporting other risk behaviors was 5.1%, and among those with no identified risk it was 0.5%; taking these two groups together yields a prevalence of 0.9% (95% confidence interval [CI] = 0.2% to 2.2%). For the women, the prevalence among injection drug users was 2.8%, among those with other risk behaviors it was 0%, and among those with no identified risk it was 0.2%; taking the last two groups together yields a prevalence of 0.2% (95% CI = 0% to 0.9%).

Risk Behaviors in the Past Year

Table 4 compares the 197 people who reported either male homosexual activity or injection drug use in the past year with the 1,573 who denied they participated in these behaviors (the number with at least one of these risk behaviors in the past year is smaller than the comparable number in Table 3 [347] because the latter includes behaviors extending over the past ten or more years). Homosexually active men and injection drug users reported higher rates of all the other risk behaviors than the rest of the population (Table 4). The latter group, however, a large majority comprised chiefly of heterosexually active people, reported substantial levels of risk. In these 1,573 men and women, the prevalence of reporting one or more of these risk behaviors in the past year was 12%.

In Table 5 we examine the race and gender distributions of these other risk behaviors among the 1,573 people who were neither homosexually active nor injection drug users. The prevalence of reporting one or more of the risk behaviors in the past year was lowest among women of Hispanic background (5%), intermediate among African-American women and men of all ethnic groups, and highest among white women (21%). The high levels of risk among white women were attributable to three main risk behaviors: having a sex partner who was an injection drug user (reported by 9%), reporting a recent history of sexually transmitted disease (9%), and having a homosexually active male sex partner (4%). For all three of these risk behaviors, the rates reported by white women exceeded those of all other race and gender subgroups.

Neighborhoods

The prevalence of HIV antibody varied among the three neighborhoods surveyed (Table 6). More than two thirds of those who were HIV-positive resided in the Western Addition, where the overall seroprevalence was 12%. The HIV seroprevalence rates were a sixth this level in Bayview-Hunter's Point (2%) and the Mission District (2%) ($P < .001$). The proportion of men reporting male homosexual activity showed the same pattern—28% in the Western Addition compared with 11% in the Mission District and 10% in the Bayview-Hunter's Point District ($P < .001$).

Although respondents in the Western Addition were significantly more likely to report an HIV-infected partner or a sexually transmitted disease ($P < .02$) and the women in this district were significantly more likely to report a homosexually active male sex partner ($P < .001$), the neighborhoods did not differ in the proportion of respondents reporting in-

TABLE 7.—*Racial Distribution of Homosexually Active Men and Human Immunodeficiency Virus (HIV) Infection in AMEN Cohort Study, by Neighborhood*

Race or Ethnicity	Western Addition			Mission District			Bayview-Hunter's Point			Total No.		
	Men, No.	Homosexually Active Men, No. (%)	HIV+ Homosexually Active Men, No. (%)	Men, No.	Homosexually Active Men, No. (%)	HIV+ Homosexually Active Men, No. (%)	Men, No.	Homosexually Active Men, No. (%)	HIV+ Homosexually Active Men, No. (%)	Men, No.	Homosexually Active Men, No. (%)	HIV+ Homosexually Active Men, No. (%)
White	157	55 (35)	30 (55)	152	23 (15)	7 (30)	18	6 (33)	1 (17)	327	84 (26)	38 (45)
African American	42	5 (12)	3 (60)	14	3 (21)	2 (67)	61	0 (0)	0 (0)	117	8 (7)	5 (63)
Hispanic	15	5 (33)	3 (60)	160	6 (4)	1 (17)	5	0 (0)	0 (0)	180	11 (6)	4 (36)
Other	12	2 (17)	2 (100)	30	3 (10)	1 (33)	9	2 (22)	0 (0)	51	7 (14)	3 (43)
Total*	226	67 (30)	38 (57)	356	35 (10)	11 (31)	93	8 (9)	1 (13)	675	110 (16)	50 (46)

AMEN = AIDS in Multiethnic Neighborhoods, HIV+ = human immunodeficiency virus-positive

*The total number of homosexually active men who are infected with HIV is 50 in this table, a smaller number than the 59 reported in Table 4 because homosexual activity is based on the past year in this table and on the past 10 years in Table 4. The percentages differ slightly from those in Table 6 because this table is restricted to those for whom HIV results are available.

jection drug use, having a sexual partner who was an injection drug user, or having unprotected sex with more than four partners.

There was significant variation in the rates of infection in homosexually active men reported in each neighborhood (Table 7); regardless of race, it was much higher in the Western Addition (57%) than in the Mission District (31%) or Bayview-Hunter's Point (13%, based on 1 case). The prevalence of homosexual activity was much higher among men who were white (26%) than among those who were African American (7%), Hispanic (6%), or of other racial backgrounds (14%). The different character of the neighborhoods is illustrated by the fact that even though most of the African-American men in our sample resided in the Bayview-Hunter's Point District, none of the eight homosexually active African-American men were Bayview residents. Although the numbers do not permit precise comparisons, the prevalence of HIV infection among homosexually active men was 63% in African-American men, 45% in white men, and 36% in Hispanic men.

Discussion

This is the first population-based study of HIV risk behaviors and HIV infection designed to sample approximately equal numbers of whites, African Americans, and Hispanics in urban neighborhoods. The study shows that HIV infection in San Francisco has occurred predominantly among homosexually active men, secondarily among injection drug users, and hardly at all in the rest of the population. Substantial numbers of people who are neither homosexually active men nor injection drug users have important HIV risk behaviors, however, the prevalence ranging from 5% to 21% across race-gender subgroups.

Current Levels of Infection

The levels of infection among homosexually active men who use injection drugs (59%), and among those who do not (32%), are comparable to those reported from the Centers for Disease Control (CDC) unblind study of similar men attending a sexually transmitted disease clinic (53% and 34%) but lower than those from the CDC blind study conducted at the same site (68% and 49%)[9] or from the San Francisco Men's Health Study in 1985 of a population-based sample in the Castro District (68% and 46%).[7] The levels of infection among injection drug users in our sample was 5%, which was similar to those in the CDC unblind study (3%) but lower than the rates in the CDC blind seroprevalence study (14%) or clinic studies (12%).[9]

The difference in HIV infection rates observed in the CDC studies between blind and unblind studies suggests a downward bias—that is, an avoidance of testing among those who are HIV-positive under conditions of confidential (as opposed to anonymous) testing. This suggests that our results, which are consistent with the estimates from the CDC unblind studies, provide a lower estimate for the actual seroprevalence in the neighborhoods examined. This interpretation is supported by findings from a household study in Dallas[19] that imputed that among those who refused to participate in the original survey but did respond to later requests and higher incentives, the HIV seroprevalence rate would be higher than it was in the group that responded initially.

Data from the CDC studies in San Francisco[9] suggest that the rate of HIV infection is 1% or less among those who are heterosexually active and do not report other risk behaviors. The levels of infection reported here—0.2% for women and 0.5% for men—are consistent with other studies. Because of the small numbers and many possible sources of error, including underreporting of risk behaviors, these point estimates of the level of infection may not represent the true population levels.

Potential for Spread of Infection

The risk behavior prevalences in this study are more important than the serologic findings in evaluating the potential for spread of the HIV epidemic into heterosexual populations. The overall prevalence of risk behaviors reported in the previous year among respondents who were not homosexually active men or injection drug users was 12%. Important risk behaviors are having a sex partner who used injection drugs (5%), having unprotected sex with more than four partners in the past year (3%), and women having a homosexually active male partner (2%). African Americans and Hispanics did not report higher levels of risk behaviors than whites. In fact, among people who were neither homosexually active nor injection drug users, white women (21%) and white men (14%) were the most likely to report one or more risk behaviors.

These behavioral data almost certainly underestimate true levels of risk behavior. Some respondents may underreport behaviors they perceive to be embarrassing,[20] and others may not be aware of their risk status. Several studies have indicated that some people who know they are HIV-positive

or who engage in high-risk behavior will conceal this information to establish a sexual relationship[21,22]; this could lead respondents in our sample to have inaccurate information about the risk behaviors or HIV status of their sexual partners. For these reasons, the observed 12% rate of engaging in HIV risk behaviors in the past year may underestimate the actual prevalence in the population. The data presented here, though indicating the relatively low infectivity of HIV through heterosexual intercourse in this population,[14] give us a basis for serious concern about future spread of the virus into populations that are currently unaffected.

Social Change and Geographic Concentration of Human Immunodeficiency Virus Infection

Geographic variation in the distribution of AIDS cases and of HIV infection has been described at all levels, from variation among countries (the Patterns I, II, and III described by the World Health Organization[23]) to variation among neighborhoods within a city (for example, high rates of infection in southwestern Belle Glade, Florida,[24] in the South Bronx section of New York City,[25] and in selected neighborhoods in San Francisco[26,27]). An important finding to emerge from studies of the geographic distribution of AIDS in the United States is the concentration of the disease in impoverished, inner-city communities[25,28] and in gay neighborhoods where many of the residents are homosexually active men.[7]

The dynamics of infection in neighborhoods have received little attention in studies of the epidemiology of AIDS. In one of the few studies of this issue, it has been argued that the virulent spread of infection in the South Bronx is related to massive social upheaval caused by the physical destruction of many acres of housing.[29,30] Neither the Castro District nor the Western Addition has suffered physical disintegration. On the contrary, both districts have experienced gentrification—a renewal and upgrading of neighborhood housing as more affluent whites replaced less affluent blacks—which is itself a manifestation of widespread social and physical change.

The Castro District was the first center of open gay life and culture. Gay men, through the Gay Liberation Movement, redefined their life-styles, and many chose to live in a setting conducive to their new choices.[31] Our study suggests that the gay community established in the Castro District has extended into an adjacent neighborhood, the Western Addition, and that this new community may have been created as part of a dramatic shift in the ethnic makeup of this area between 1980 and 1990. According to the census, the Western Addition, whose population was 70% African American and 19% white in the 1980 census, is no longer predominantly African American. The 1990 census indicates that African-American residents made up 51% of the neighborhood's population in 1990 and whites made up 32%.

We are unable to determine how this change in the community's ethnic composition may have changed other facets of community life. The Western Addition, however, had the largest proportion of homosexually active men in our study, the highest prevalence of HIV antibody among homosexually active men, and, as noted here, the greatest proportionate shift in ethnic distribution between 1980 and 1990. These findings suggest an association between a spatial diffusion of HIV infection and changes in the demographic composition of communities.

Conclusion

We have examined the prevalence of HIV infection and its antecedent risk behaviors in subgroups of the population defined by sexual orientation, ethnic group, and neighborhood. At present, the infection is most prevalent among homosexually active men living in the Western Addition, but it is also common in homosexually active men living elsewhere and in injection drug users. Infection is rare in the rest of the population, but given the prevalence of risk behaviors for acquiring HIV heterosexually, the potential is high for the future spread of infection into currently unaffected groups. Further, the model for HIV dissemination suggested by these data has important implications for other areas that are epicenters of the AIDS epidemic. Our data indicate that the spread of HIV infection will be slow, but the factors affecting the rate of spread are still incompletely understood and may change over time. Studies should also include an examination of patterns of spatial contagion and network diffusion of HIV infection in other epidemic epicenters such as New York City; Newark, New Jersey; and Miami, Florida.

It is also evident that prevention efforts need to be redoubled, particularly among persons who engage in risky behaviors and who fail to perceive (or who deny) the degree to which they are at risk. Even for behaviors that are associated with relatively low probabilities of acquiring HIV infection, any possibility of spread must lead us to encourage primary prevention through HIV antibody testing and safer sexual practices.[32-34]

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* * *

THIS SORROW WE ARE BOUND TO FACE

As if we are driving along the highway, a pleasant
straight-a-way, high-speed thoroughfare, and ahead
we sight it, the first stop-light in a thousand miles.

Its color, faintly visible, is green. Beside us,
a few vehicles pull into emergency lanes.
Just as we decide the light will remain in our favor,

as you relax your grip, the color changes to yellow.
Lined up, side-traffic is waiting to enter the intersection.
Playing the odds, relying on others, more cautious,

to look out for you, should you hold the gas pedal
to the floor? Trusting to luck, should you speed up,
risk colliding with those gunning engines, eager

to rush forward at the first sign of green? Or,
tapping the brake, should you pull toward the right,
continue in low gear? Swerve into a parking lane?

Stop? So with us, with this disease the doctors
have diagnosed: no side-roads, no turn-offs,
no way we can go but ahead. Already

the caution light is lit, we coast to a halt
as others, at full-speed, pull farther
and farther in front, as we, at a standstill, recede.

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